Using Curriculum Topic Study to Enhance Achievement in K-12 Science: Preliminary Outcomes

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Goals

- Increase the academic achievement of students in math and science by enhancing the content knowledge and pedagogical content knowledge through increased understanding and use of the New Jersey Core Curriculum Content Standards (NJCCCS) by classroom teachers
- Progression of science & mathematics topics through three years
- Preliminary outcomes for K-12 science teacher and student performance from the first year (life sciences) are presented here

Professional Development (PD) Program

- 124 hrs PD for each of 33 participants from 18 partner districts (up to 9 grad credits)
- 2 wk summer institute plus 4 PD workshops during school year (3 f2f & 1 online) and monthly classroom visits
- Cross-grade Teacher Exchange Program
- Professional Learning Communities & online support

Outcomes: Student Content Knowledge

<table>
<thead>
<tr>
<th>Group (N)</th>
<th>Pre-Test1</th>
<th>Post-Test1</th>
<th>Paired diff.2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment students</td>
<td>4593</td>
<td>8.6±2.6</td>
<td>9.8±5.0</td>
<td>1.2</td>
</tr>
<tr>
<td>6th grade</td>
<td>10.7±2.2</td>
<td>12.1±2.1</td>
<td>8.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>7th grade</td>
<td>14.4±2.5</td>
<td>15.4±2.5</td>
<td>1.0</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>Comparison students (285)3,5</td>
<td>9.2±2.7</td>
<td>10.6±2.8</td>
<td>1.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>6th grade</td>
<td>10.5±3.1</td>
<td>12.1±3.4</td>
<td>1.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

1 Pre- and post-assessments were conducted with middle school students only
2 Treatment and Comparison students' scores on the post-test were not significantly different in the first-grade cohort (p = 0.116), however, this result may have been due, in part, to prior knowledge (comparison with grade students had a higher mean on the pre-test although not significant [p = 0.072])
3 Difference in post- vs. pre-test score per item (paired t-test p = 0.02)
4 * Students who completed pre- and post-tests; 5 6th grade Coh 3 participants received training

Hypothesis

- A rigorous examination of the NJCCCS using the Curriculum Topic Study (CTS) process will result in an increase in teacher and student content knowledge and an increase in teacher pedagogical knowledge...or, in other words...
- A process-oriented professional development model will enhance content knowledge if the process is adopted and practiced by the attendees

Method: Curriculum Topic Study (CTS)

- CTS is a method and index for linking curriculum topics to recognized authorities on curriculum content and pedagogy
- Developed by Page Keeley, Maine Math and Science Alliance
- Much of the substance of CTS takes the form of tables of references to the authoritative resources (e.g., AAAS Benchmarks in Science Literacy, Atlas of Science Literacy, Science for All Americans)

Teacher and Student Evaluation: Quasi-experimental Study

Outcomes: Content Area

<table>
<thead>
<tr>
<th>Content area</th>
<th>Treatment1</th>
<th>p value</th>
<th>Comparison1</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Practices</td>
<td>0.08/2</td>
<td>0.096</td>
<td>0.15</td>
<td>0.013</td>
</tr>
<tr>
<td>Organization &amp; Development</td>
<td>0.41/4</td>
<td>&lt;0.001</td>
<td>0.48</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Matter &amp; Energy Transformations</td>
<td>0.27/4</td>
<td>&lt;0.001</td>
<td>0.55</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Interdependence</td>
<td>0.46/4</td>
<td>&lt;0.001</td>
<td>0.27</td>
<td>0.002</td>
</tr>
<tr>
<td>Heredity &amp; Reproduction</td>
<td>0.32/4</td>
<td>&lt;0.001</td>
<td>0.20</td>
<td>0.038</td>
</tr>
</tbody>
</table>

* Most partner districts teach life science topics in 7th grade

Workshop Content and Teacher Performance: AAAS Atlas Use

- AAAS Atlas of Science Literacy Topics
- CTEAMS QUESTIONS
- CTEAMS ACTIVITIES
- TEACHER-REPORTED FOCUS

Outcomes: 7th Grade Students1 by Content Area

- 9 of 10 vertical teams had at least 1 workshop participant serve on curriculum development committees at the district level
- 1 participant designated to develop ELL science curriculum in grades 5 to 8
- 2 presentations at the NJ Science Convention; 1 presentation at the NSTA STEM Expo May ’12; oral presentation at USDOE STEM Regional Meeting 2011

Summary & Conclusions

- While overall achievement of students could not be correlated with workshop participation, achievement of the 7th grade cohort of treatment students (aligned with life science focus) appeared to show a positive trend in gains in content knowledge
- Elementary treatment teachers showed a significant increase in post-test scores
- Presentation of a limited scope of content in the context of CTS training led to broader investigation of NJCCCS and Atlas topics by participants